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(54) Linear actuator.

(57) For certain linear actuators and for certain uses hereof it is necessary to furnish actuators with a self-locking spindle, and suffer the disadvantages connected therewith. However, by using a coil spring (20) which with a number of windings is laid around one end of the spindle (6) or a cylindrical element of the power transmission coupling for this and further arrange the spring such that it allows the spindle to rotate freely during the projecting movement but during the retracting movement applies a braking force, it is possible to make a non-self-locking spindle act as self-locking. Thereby in said situations advantage could be made of the virtues of the non-self-locking spindles.

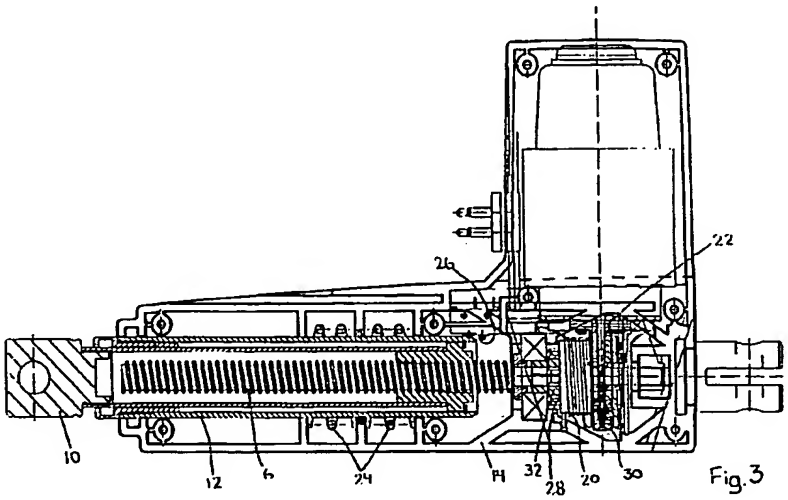

Fig.3

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The present invention relates to a linear actuator comprising a screw spindle rotatable in either direction, a drive nut axially displaceable on the screw spindle and connected to a driving rod, and a reversible electric motor driving the screw spindle via a gear and project the driving rod or retracting it respectively depending on the direction of rotation of the spindle.

For certain purposes and constructions it is necessary to furnish actuators with a self-locking spindle, which requires a considerably higher effect, up to 50%. Furthermore, self-locking spindles have a very fine innate pitch. However, by the invention it is reckoned that also in said situations spindles of the non-self-locking type can be used by using a braking spring in the shape of a flat coil spring, which with a number of windings is laid around one end of the spindle or power transmission coupling for this. The braking spring is arranged such that it allows the spindle to rotate freely when it is loaded which normally is the projecting movement. In the reversing movement a braking force is applied to the spindle, this braking force being a compromise such that the spindle is locked against rotation when the motor is inoperable, but being sufficiently small such that it can be overcome by the motor. In other words the spring is arranged with its winding direction such that it is loosened i.e. unwound in the projecting movement while the windings are tightened around the spindle or power transmission coupling wherever the spring may be placed and thereby exerts a braking effect. The necessary braking force is in fact very modest as it shall only support the inertia in the construction and can be determined exactly by the number of windings.

The invention will be described further in the following with reference to the accompanying drawing in which,

Fig. 1 shows a longitudinal section through a linear actuator according to the invention,

Fig. 2 shows an enlarged view seen from above of the driven end of the actuator spindle, and

Fig. 3 shows a longitudinal section through another embodiment of a linear actuator according to the invention.

In fig. 1 is shown a longitudinal section through a linear actuator comprising a reversible electric motor 2 which by a set of bevelled gears 4 is driving a spindle 6. On the spindle is arranged a longitudinal displaceable ball drive nut 8 to which is attached a drive rod 10 in the nature of a tube telescopically arranged in a protective tube embedded in the actuator housing 14. The driven end of the spindle is resting in a ball bearing 16 arranged between one of the two bevelled gears 4A and a cylindrical element 18. Around the cylindrical element is laid a braking spring in the nature of a flat helical spring 20 with one end fixed in the actuator housing. The spring has its windings arranged around the cylindrical element in such a manner that it does not oppose the spindle in the rotating direction for projecting the drive rod 10, but when reversing the rotating direction for reversing the drive rod then the spring applies a braking force on the cylindrical element the size of which is tuned such that the spindle appears self-locking when the motor is cut off. At projecting the drive rod the direction of rotation of the spindle causes the spring which lies tightly against the cylindrical element metaphoriclaly speaking to open as the friction from the cylindrical element acts against the winding direction of the spring and thereby does not or only to a negligible extent influences on the spindle rotation. During reversing the spring on the contrary is tightened around the cylindrical element and causes the self-locking braking effect on the spindle. An enlarged view of the end of the spindle is shown in fig. 2 of the drawing.

In fig. 3 of the drawing is shown a linear actuator which differs from the previous one especially in that the spindle is driven by a worm gear 22, and in that the outer tube 12 is arranged axially displaceable between two springs 24 for operating an end stop switch 26 for cutting off the motor when the drive 26 reaches the end positions. Further the braking spring 20 is here laid around a cylindrical element 28 in the worm gear. This is an cylindrical element 28 in a multi-spline transmission between the worm wheel and the spindle. The cylindrical element is integrated with the worm wheel 30 and contains a cylindrical piece 32 on the end of the spindle as the spring rests in grooves internally in the cylindrical piece. The braking spring is fixed with one end in the part of the actuator housing which houses the transmission. The braking spring acts as before namely such that it does not counteract the rotation of the spindle during projection of the drive rod but loads the transmission during reversing of the drive rod with a force sufficient to the spindle appears self-locking when the motor is cut off.

Where one previously was forced to use spindles of the selflocking type, the invention allows the possibility also in said cases of using spindles of the non-selflocking type and achieving the associated advantages such as less friction and thereby a reduced power consumption.

Claims

1. A linear actuator comprising a non-self-locking screw spindle (6) rotatable in either direction, a driving nut (8) axially displaceable on the screw spindle and connected to a drive rod (10), and a reversible electric motor (2) driving

the screw spindle via a gear and respectively projecting or retracting the drive rod depending on the direction of rotation of the spindle characterized in that it comprises at least one coil spring (20) with a number of windings arranged around one end of the spindle or a cylindrical element of the power transmission coupling, and arranged such that it allows free rotation of the spindle during the projection movement but applies a braking force on the spindle in the retracting movement, balanced such that the spindle appears self-locking.

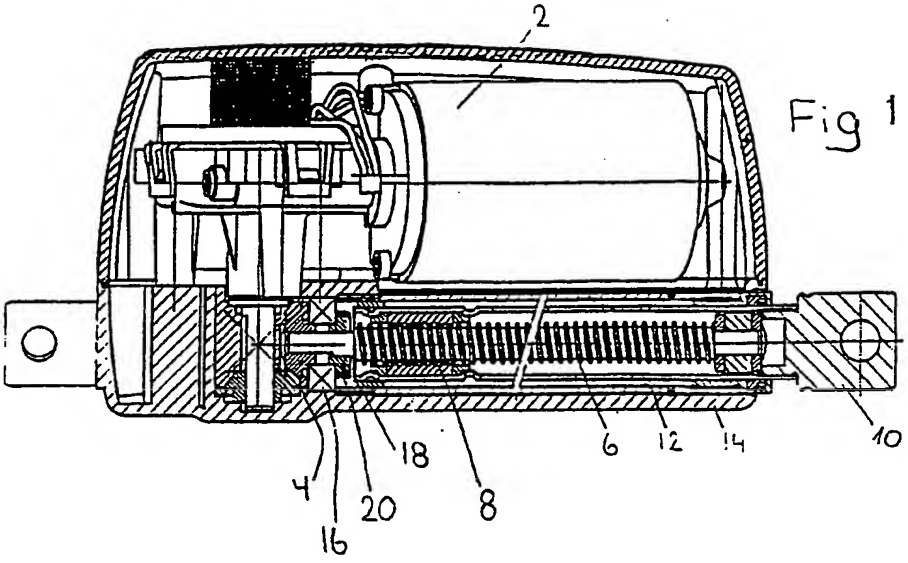

Fig 1

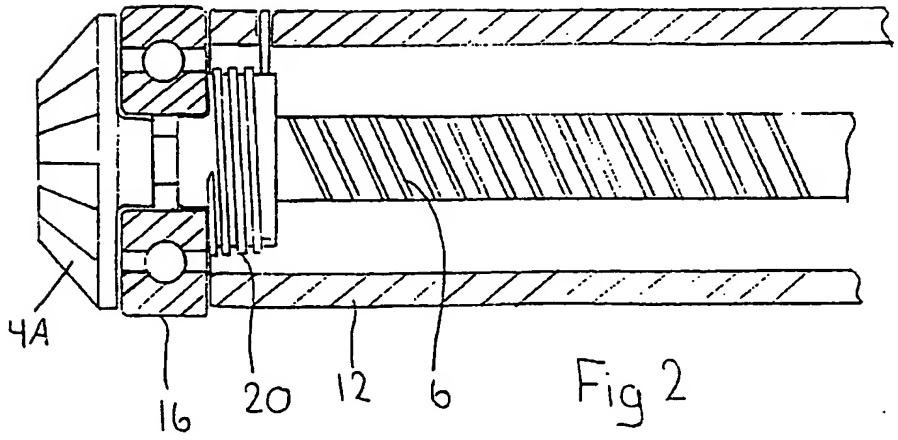

Fig 2

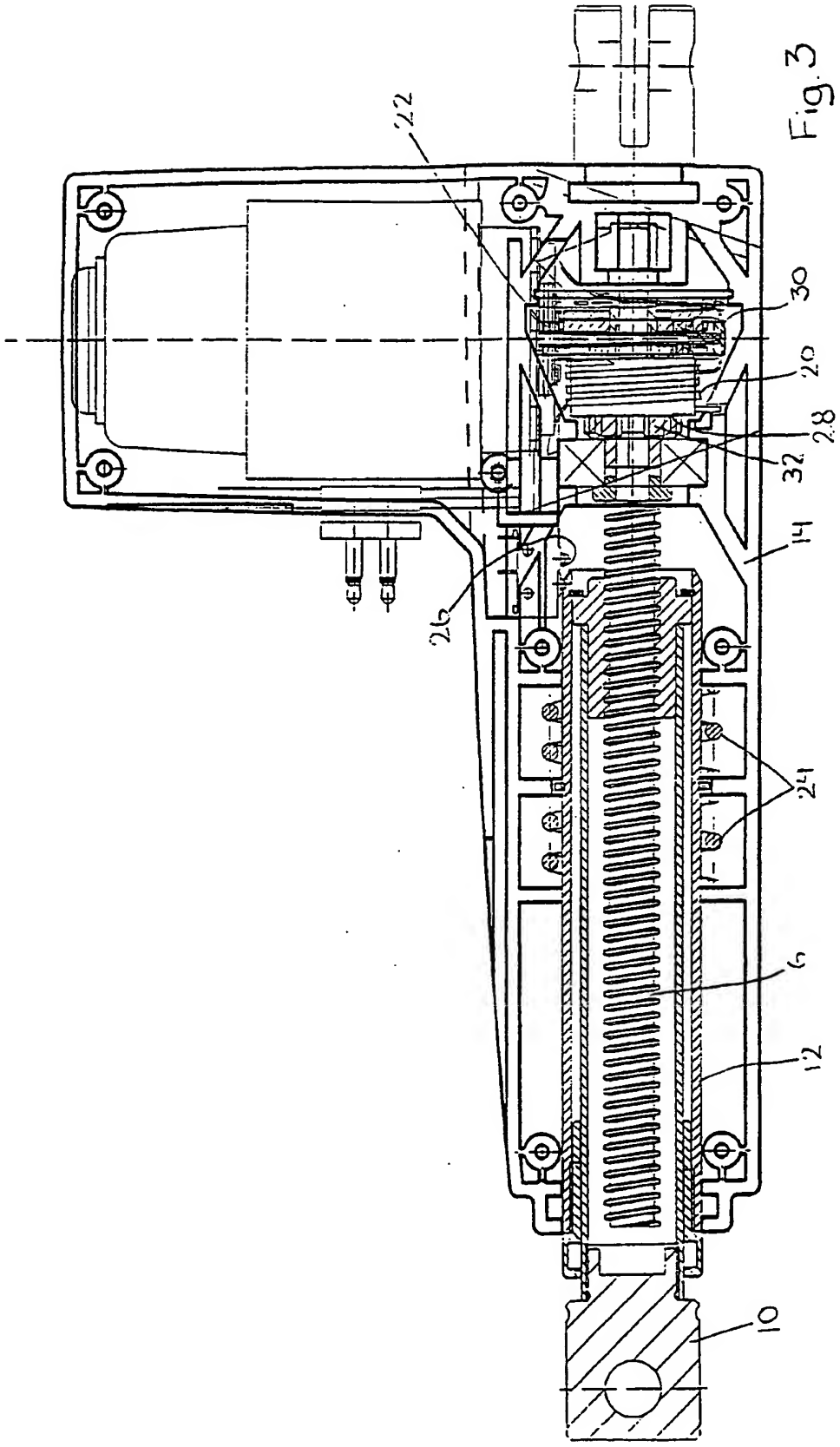

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 95 61 0001

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-4 246 991 (OLDAKOWSKI STEPHEN Z) 27 January 1981 * the whole document *	1	F16H25/20
Y	EP-A-0 577 541 (LINAK AS) 5 January 1994 * the whole document *	1	
Y	EP-A-0 259 641 (SKF NOVA AB) 16 March 1988 * the whole document *	1	
Y	EP-A-0 258 571 (SKF NOVA AB) 9 March 1988 * the whole document *	1	
Y	FR-A-2 088 239 (BULL GENERAL ELECTRIC) 7 January 1972 * figures 1,3 *	1	
A	EP-A-0 226 065 (SKF NOVA AB) 24 June 1987 * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F16H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 April 1995	Vingerhoets, A

CATEGORY OF CITED DOCUMENTS

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